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The Impact of Structural Reforms on Poverty

A Simple Methodology with Extensions

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Abstract

Structural reforms are often designed to change the prices of key goods and services. Since the overall intention of such reforms is the reduction of poverty, it is important to understand how the resulting price changes affect the poor. However, organizations seeking to provide timely advice to policymakers in developing countries often do not have the data and resources needed to undertake the most sophisticated approaches to such analysis. McCulloch outlines a simple methodology based on the analysis of household survey data to estimate the first-order impact of a variety of structural reforms. He also elaborates on the ways in which this methodology may be extended in a flexible way to account for particular features of a country in question. Finally, he outlines the direction of some extensions on the approach to tackle dynamics, risk, and qualitative poverty analysis.

This paper—a product of the International Trade Department, Poverty Reduction and Economic Management Vice Presidency—is part of a larger effort in the Bank to develop better methodologies for understanding the impact of structural reforms such as trade liberalization, privatization, and tax and subsidy reforms on poverty. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Melanie Faltas, room MC2-402, telephone 202-458-2323, fax 202-522-7551, email address mfaltas@worldbank.org. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at nmcculloch@worldbank.org. August 2003. (41 pages)

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1. Introduction

For many years there has been considerable interest in the impact of economic reforms upon poverty and more generally on the distribution of welfare within society. This interest has arisen from a number of different sources. A large number of NGO and civil society organizations, along with many developing country governments have expressed concern about the potential negative distributional impact of structural reforms. At the same time much academic work has pointed to the wide variety of outcomes resulting from reforms in different countries.[1]

Economic reforms are typically split into two categories: macroeconomic reforms, often pursued under the auspices of the IMF; and structural or price reforms designed to improve resource allocation and increase efficiency. Although the maintenance of macroeconomic stability remains the cornerstone of effective economic development, there has been a stronger emphasis in recent years on structural reforms since these are key to achieving pro-poor growth.

Understanding the impact of structural or price reforms on poverty is key in several different areas of reform. For example, the imposition or removal of a tariff on the staple food can have a major impact upon the incomes of the poor. The same is true of a reduction in the transaction costs faced by the poor in reaching markets, through for example, investments in rural feeder roads, policies to enhance competition in the transportation sector, or marketing reforms. Similarly utility reform and privatization often have a dramatic impact upon the prices for such services and for poverty if the purchase of such services is important for the poor. And the same is true of changes in the wide variety of taxes and subsidies which may be imposed by the government.[2] The central characteristic of all these reforms is that they are designed to change prices and thereby influence resource allocation to different activities. Therefore, for the purpose of understanding the impact of structural reforms upon the poor, it is essential to have a good methodology for linking price changes to changes in poverty.

The theoretical framework for linking such reforms to poverty is probably best developed in the area of trade (see Winters (2000) and McCulloch, Winters and Cirera (2001)), although the approach is generally applicable to a wide range of price reforms. The analysis of the linkages between price reforms, including trade reform, and poverty is complex and there are a large variety of different methods available (Reimer (2002) and McCulloch, Winters and Cirera (2001) provide reviews of methodologies and papers).[3] In an ideal world the relationship between price reform and poverty could be accurately predicted using a general equilibrium model with a suitably disaggregated household

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[1] See Cornia, Jolly and Stewart (1987) for an early critique of structural adjustment reforms.

[2] See Ahmad and Stern (1991) for a comprehensive review of the issues raised by taxation in developing countries. Deaton (1997) provides a succinct statement of some of the methodological problems.

[3] See also http://www1.worldbank.org/wbiep/trade/poverty/papers.htm for a selection of papers. The World Bank also provide a "toolkit" of methods for conducting poverty and social impact analysis – see http://www.worldbank.org/poverty/psia.

sector. If the macroeconomic and microeconomic data required for such an approach are available and reasonably accurate, the parameters of the model are empirically estimated from the available data, and the functional forms of the behavioural relationships in the model are broadly correct, then such models can provide useful ex-ante predictions of the impact of price shocks upon different types of households and thereby upon poverty. Furthermore, even where these conditions are not completly satisfied, CGE models can provide a valuable indication of the sorts of effects which we might expect *given* any set of assumptions about data, parameters and behavioural relationships and thereby give an indication of how sensitive the results are to particular sets of assumptions.

CGE models have now been used to examine the impact of a variety of price reforms (including trade, marketing and shifts in agricultural technology) in a large number of different countries.[4] However, the data requirements for such models can be considerable. Unless a recent Social Account Matrix (SAM) is already available, the construction of a useable SAM can take substantial time and expertise. Furthermore, the econometric estimation of behavioural parameters (as opposed to merely calibrating such parameters against the original SAM) can be complex and time-consuming and the choice of functional form for the behavioural relationships, although based upon plausible arguments, is essentially arbitrary (Deaton, 1997).

To reduce the data and resource requirements, many analysts have used simpler partial equilibrium techniques which can be implemented more quickly on readily available data. Such analysis has typically involved detailed microeconometric work on household survey datasets. This can yield information about the pattern of consumption and how it varies across different groups (e.g. deciles, gender of household head, type of main activity, region etc). In addition surveys sometimes have income information which can tell us the relative importance of different sources of income again disaggregated by different groups. Such work can provide a rich picture of the poverty profile of any given country and an initial indication of the likely impact of reforms.

This paper describes a simple practical methodology for estimating the poverty impact of price reforms which can be implemented in a reasonably short period of time using almost universally available household survey data. This methodology is not new, but by providing a comprehensive description of the methodology in one paper, we hope that it will become a standard "minimum" analysis of the potential impact of such reforms upon the poor. We provide some examples of the application of the methodology from the Diagnostic Trade Integration Studies conducted as part of the Integrated Framework program[5] to assist Least Developed Countries with integration into the world economy.

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[4] For example, IFPRI's Trade and Macroeconomic division http://www.ifpri.org/ has conducted numerous studies of this kind.

[5] The Integrated Framework (IF) was set up by the WTO Ministerial meeting in Singapore in 1996 to help integrate LDCs into the world economy. The work programme includes the preparation of country specific Diagnostic Trade Integration Studies some of which include chapters on the linkage between trade and poverty (http://www.integratedframework.org/) provides more information on the Integrated Framework. DTIS studies for Cambodia, Madagascar and Mauritania are available from http://if.wto.org/documents_e.htm; draft DTIS studies exist for Yemen, Senegal, Malawi and Lesotho.

In addition, since the reforms which are likely to have the greatest impact upon the poor will vary from country to country, we provide some pointers to how the analysis can be made more sophisticated in the areas of most importance to a particular country. We conclude with a discussion of areas for future research.

2. A Basic Methodology[6]

The basic methodology draws on the approach of Nicita, Olarreaga and Soloaga (2002) in their study of the impact of trade reform in Cambodia. They write the income of a household as the sum of three components: own production, wage employment and net transfers. Own production includes both the value-added from farming as well as the value-added from any other enterprises owned by the households (e.g. small enterprises engaged in trading or the provision of services). Wage employment includes all payments made by those outside the household for the labour services of members of the household e.g. payments for working on someone else's farm, or the payment resulting from a job. Net transfers refers to the net payments from the government (pensions, grants and other transfers minus any fees or taxes) as well as net transfers from other households e.g. net remittances.

The idea behind the methodology is that in the short run households cannot change their activities in response to a change in prices (in the long run households may well change their activities as a result of the price change – indeed this may be the intention of the reforms). In this case income from own production and wage employment can be written as the product of a set of prices and a set of quantities. For example, income from own production is equal to the prices of the outputs produced times the quantity of output produced minus the prices of the inputs used times the quantities of inputs used. Similarly income from wage employment can be written as wages times the (net) quantity of labour sold.[7] If households are unable to change their activities immediately when prices change, then a first approximation to the change in their income resulting from a price shock can be given by the sum of the price changes times the original quantities produced. Thus if the rice price increases, a first approximation to the increase in income for rice farmers is given simply by the change in the rice price times the quantity of rice produced. Similarly if the wage increases, a first approximation of the benefit is given by the change in the wage times the quantity of labour sold.

However, households consume as well as produce and price changes affect consumption too. Just as with production, price changes will change the long run consumption pattern

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Work has been initiated on Ethiopia, Burundi, Nepal, Guinea, Eritrea. A draft DTIS study has also been done for Armenia and work is underway in several low income countries including: Georgia, Moldova, Kyrgyz Republic and Azerbaijan).

[6] The basic methodology is based on "A simple methodology to assess the poverty impact of economic policies using household data. An application to Cambodia. Nicita, Olarreaga and Soloaga (2002). See Annex 1 for details.

[7] Transfer income is harder to disaggregate in this way – see the section on remittances below.

of households, causing them to consume relatively more of cheaper goods and relatively less of goods which have become more expensive. Also price changes will affect real incomes making households consume more or less of all goods. But, in the short run we can make the same assumption as for production – that the quantities of goods consumed by the household do not change. If this is the case then a first approximation of the increase in the cost associated with a price increase can be given simply by the change in the price times the quantity of the good originally consumed.

Putting the production and consumption effects together, it is possible to show that the change in welfare[8] can be approximated as the change in income minus the change in consumption. This makes intuitive sense: an increase in the price of a good which is both produced and consumed will increase income and also increase the cost of achieving the original level of consumption – the difference between these is therefore an approximation to the welfare change.

Note that the basic methodology is a "worst case" analysis because it assumes no quantity response at all – if households are able to substitute away from the consumption of goods whose price has risen or to substitute towards the production of such goods then it must be better off than the situation in which it could not do so. In some respects this makes the simple model more attractive because if the model points to a relatively small negative or positive impact then the incorporation of substitution effects can only make the situation better.

Finally, if one wishes to express the change in welfare as a percentage then one can divide it by the original level of welfare (given by the initial level of income). If we do this we can write[9]:

$$\frac{\Delta W}{W} = \left[\sum_j IS_j^O \left(\frac{\Delta p_j^O}{p_j^O}\right) - \sum_k BS_k^I \left(\frac{\Delta p_k^I}{p_k^I}\right)\right] + \sum_f IS_f^W \left(\frac{\Delta w_f}{w_f}\right) - \sum_i BS_j^C \left(\frac{\Delta p_j^C}{p_j^C}\right) \quad (1)$$

where W is the measure of welfare, IS_j^O indicates the value of output j as a share of household income, $\left(\Delta p_j^O / p_j^O\right)$ is the percentage change in the price of output j, BS_k^I is the budget share of input costs, IS_j^W is the income share of net factor income from factor f (in most cases equal to the income share of wages), and BS_j^C is the budget share of good j in consumption.[10]

[8] Given by money metric utility – see Annex 1 for details.

[9] See Minot and Goletti (2000) Appendix 2 for a full derivation.

[10] We also assume no change in transfer income – see Annex 1 for an expanded expression with transfer income.

Equation (1) is the core of the basic methodology. The key thing to note about this equation is that the first-order percentage change in welfare can be calculated using only information on the income shares of different income sources, the budget shares of different items of expenditure, and the percentage changes in prices experienced. Such information is readily available from many household surveys making the application of this methodology relatively straightforward in a large number of countries.

3. Application of the Basic Methodology

Given the above methodology, the impact of a price change upon a household will clearly depend on two things: which prices change (and by how much); and the nature of the household. We consider each issue in turn.

Determining price changes

The easiest way to "determine" price changes is to assume them. That is, the above methodology can be used to explore the potential impact upon different groups of households of a set of possible price changes. This is particularly valuable where the price changes likely to result from the implementation of a reform are not known with any degree of accuracy (or where the analysis of how the policy reforms might change prices is complex, costly or simply has not yet been undertaken). Even where price changes have been predicted by some other model, assuming a set of exogenous price changes allows policymakers to conduct sensitivity analysis on the poverty impact of the models predictions.

Rather than assuming exogenous changes in the prices faced by households, one might instead wish to assume exogenous changes in a policy related price and some transmission mechanism between the policy related price and the price faced by the household. For example, if one is interested in the poverty impact of a 10 percent increase in the rice tariff we could write down the price of tradable goods as a function of the various taxes and costs which incur between the border and the household. i.e.

$$p^h = p^w.(1-t) \text{ for output prices and}$$
$$p^h = p^w.(1+t) \text{ for the price of tradeable inputs and consumption goods} \qquad (2)$$

where p^h is the price experienced by the household, p^w is the world price and t is the tariff, tax or unit cost between the border and the household. If we know the world price and the tax then we can calculate the percentage change in the household price for any change in the tax.[11] Alternatively one could treat the tax as endogenous and use the unit

[11] In the simple case shown in equation (2) the percentage change in the household price will be equal to $\alpha t/(1+t)$ where α is the percentage change in the tariff on an input; or $-\alpha t/(1-t)$ for an output.

price experienced by the household to calculate the total unit transaction cost between the border and the household and then simulate a percentage reduction in this cost.

The more detail one has regarding the transmission of prices from the policy price to the price faced by the household, the more accurately one can predict the likely percentage change in price faced by the household. For example if information on transport costs is available between different regions and one wishes to simulate the impact of a particular infrastructure development on the price of a tradeable good which is not produced domestically then we can write:

$$p_r^h = p^w.(1+t)(1+t_r) \tag{3}$$

where p_r^h is the price faced by household h in region r, t is the tax at the border and t_r is the transport cost from the border to region r. One may then use the information about the different effects which the infrastructure development may have on transport costs between the border and each region to determine the likely impact of the infrastructure development on the prices faced by households in each region.

One may also simulate technological shifts in the same way. For example, Nicita, Olarreaga and Soloaga (2002) write the value of rice output as:

$$\text{Value of Rice Output} = q^{paddy}.(1-phl^{paddy}).\lambda.(1-\alpha).(1-t^{rice}).p^{rice} \tag{4}$$

Where q^{paddy} is the quantity of paddy produced, phl^{paddy} is the post harvest losses, λ is the milling yield of paddy-to-rice, $(1-\alpha)$ is the milling unit transformation costs, t^{rice} is the tax on rice and p^{rice} is the world price of rice. They then simulate changes in technological parameters e.g. improved storage lowering post-harvest losses, improved efficiency raising milling transformation or lowering transformation costs, as well as changes in the tax rate (see Nicita, Olarreaga and Soloaga (2002) for details).

Similarly, if the price change is the result of changing a tax or subsidy applied by the government on a particular good or service, then the simplest possible approach is to assume that there is a proportional increase in the consumer price, while the producer price remains fixed. If estimates of the own price elasticity of demand and supply are available, then a better approximation to the effect upon consumer and producer prices can be found by calculating the price at which the market clears when a wedge equal to the tax is placed between the consumer and producer prices.[12]

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[12] The percentage change in producer prices will be given by $E^d t/(1-E^d t)$; the percentage change in consumer prices will be given by $E^s t/(1-E^d t)$ where $E^d = \varepsilon^d/(\varepsilon^s - \varepsilon^d)$, $E^s = \varepsilon^s/(\varepsilon^s - \varepsilon^d)$, ε^d is the demand elasticity, ε^s is the supply elasticity and t is the ad valorem tax rate.

Thus there are a large number of ways in which one can derive plausible price changes resulting from policy reforms. However, the impact of these price changes upon the poor depends on the nature of the household, to which we now turn.

The Nature of the Household

The impact of a price change upon a household will clearly depend on the relative importance of different sources of income and of different goods in the consumption basket. For example, if the price of a staple food rises sharply then net producers will benefit, whereas net consumers will lose, but the extent of the gain or loss depends upon how much income depends upon the production of this good and how important this good is in the household's consumption basket. Consequently, the best place to start in determining the impact of a price shock is to obtain, for different groups in society, information about the relative importance of different sources of income and the relative importance of different goods in household consumption. Table 1 shows a typical table, from Cambodia, of sources of income for different deciles of the consumption distribution; Table 2 shows the expenditure shares, by decile of per capita consumption.

Table 1: Contributions to income in Cambodia from different sources (percent)

	Deciles										
Source of Income:	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***avg***
Self employment	67.8	71.4	71.7	70.3	73.6	68.5	71.2	70.7	63.3	36.3	60.9
• from cultivation	27.8	29.7	31.1	30.3	31.9	32.1	30.6	32.3	19.8	3.2	22.4
from rice cultivation	21.4	24.3	25.3	23.6	25.7	25.0	22.7	20.4	9.7	2.1	16.3
from other crops	6.4	5.4	5.8	6.7	6.2	7.1	7.9	11.9	10.1	1.1	6.1
• from livestock	16.6	14.3	14.2	13.0	12.4	11.9	11.6	12.0	8.3	1.5	9.4
• from fish growing, etc	6.1	7.1	5.5	8.7	6.9	6.8	8.7	7.1	5.2	2.1	5.6
• from forestry and hunting	8.3	10.2	9.7	7.3	7.7	7.9	8.1	6.1	4.9	0.6	5.7
• from non farming activities	8.9	10.0	11.2	10.9	14.7	9.8	12.2	13.2	25.1	29.0	17.7
Other sources	32.2	28.6	28.3	29.7	26.4	31.5	28.8	29.3	36.8	63.9	39.1
• from wages	19.0	15.0	15.9	14.5	14.3	18.5	17.6	16.5	21.0	30.2	20.5
• from remittances	1.2	1.9	1.6	2.8	1.3	2.4	1.6	1.7	2.3	2.6	2.1
• other (rents, dividends, etc)	12.1	11.7	10.9	12.4	10.8	10.6	9.6	11.1	13.4	31.0	16.5
Total	100	100	100	100	100	100	100	100	100	100	100

Source: CSES Survey 2001

Table 1 shows that income from self-employment is the most important source of income for the vast majority of the population, only falling substantially below 70% of income for the top two deciles. Most of this income comes from cultivation, particularly rice cultivation, but livestock and forestry products are also of importance to the poor. The

poorest decile obtain a higher share of their income from wages than all except the two highest deciles, probably reflecting landlessness among the poorest households in Cambodia. The most striking thing to note from Table 1 is the dramatic differences between the top two deciles and the rest of the population. The rich in Cambodia (and in many other countries) really are different, typically earning a far higher share of their income from non-farming activities, wages, and rental income than the rest of the population. Given that the top two deciles of most populations tend to live in the major urban centers and are much more closely connected to the policy process than most other groups, it is important to analyse policies to see if they are really serving the interests of the majority of the population (and in particular the poor) rather than those of the, rather different, top two deciles.

Table 2: Expenditure shares in Cambodia by decile of per capita consumption (percent)

Consumption item	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*avg*
Food Total	75.7	76.3	76.0	73.7	73.7	72.6	72.0	70.3	64.4	38.6	63.5
▪ Rice, all varieties	28.4	23.3	22.7	20.7	20.6	18.9	17.5	15.1	12.5	5.8	15.6
▪ Fish & fish products	9.9	11.1	10.6	10.5	10.9	10.8	10.0	10.0	9.2	5.0	8.9
▪ All other consumption items	37.4	41.9	42.7	42.5	42.2	43.0	44.5	45.2	42.7	27.8	39.0
Non Food Total	24.4	23.8	24.1	26.4	26.3	27.5	28.0	29.7	35.6	61.4	36.5
▪ Housing, fuel and transportation [a]	15.7	15.5	15.2	17.1	17.3	17.4	17.5	19.4	24.1	46.7	25.5
▪ Clothing [b]	2.9	2.8	3.0	3.0	2.8	3.4	3.4	3.2	2.9	2.3	2.9
▪ Other expenditures [c]	5.8	5.4	5.9	6.2	6.1	6.6	7.1	7.1	8.6	12.4	8.2

[a] Includes house rent (rental value of subsidized housing, rental value of owner-occupied housing, hotel charges), house maintenance and repair, water and fuel, medical care, transportation and communication, and personal care

[b] Clothing and footwear (tailored clothes, ready-made clothes, shoes, etc.)

[c] Includes furniture and household equipment and operation, expenditures in recreation, education , personal effects and miscellaneous items.

Source: CSES Survey 2001.

Table 2 shows the expenditure shares on different commodity groups broken down by the same per capita consumption decile groups as above. Again we see a remarkable homogeneity across the bottom eight deciles and dramatic differences for the top two deciles. Food expenditure accounts for over 70% of total expenditure for the bottom 80% of the population, but rice consumption increases in importance for poorer households, whilst the share of all other consumption items (except fish and fish products) declines. Similarly non-food shares are quite similar for the bottom eight deciles, with the share of housing, fuel and transportation rising dramatically for the top two deciles.

Taken together Tables 1 and 2 give us a good indication of the likely initial impact of a given price shock. Clearly changes in rice prices will have the largest impact given their large share in both income and consumption. Of course what matters is the households *net* consumption position; the tables suggest that the poorest decile will be net consumers on average (28.4% of their consumption is on rice, 21.4% of their income is from rice) as are the top two deciles, whilst all other deciles are net producers. Thus a sharp increase in the rice price may hurt the poorest, but help the not quite so poor at the same time. The tables also give us insight into issues which might not otherwise be apparent. For example, decreases in livestock prices could hurt the poor to a significant extent, but would be of much less significance for the upper deciles of the population. Similarly shifts in wage income will matter more to the poorest decile than to slightly less poor households in deciles 2 to 5. And increases in housing, fuel and transportation costs will hit the richest hard, but will have a much smaller effect upon the poorest 80% of the population. Thus a careful examination of the income sources and expenditure shares of the population can provide much of the "story" about the potential impact of price shocks upon the poor.

The ability to tell a relevant story about who is affected by various reforms also depends upon the ways in which households are grouped. Tables 1 and 2 grouped households into deciles of per capita consumption expenditure, which is a natural grouping if one is interested in determining the impact upon the poor. However, deciles of consumption expenditure are rarely a relevant group for policy purposes; rather policymakers tend to be interested in what the effects of a reform are for functional or geographical groupings e.g. rice farmers versus informal urban workers or Western province versus Eastern Province. Indeed there are an infinite variety of possible groupings e.g. educational level, gender of household head, ethnicity, location, principle activity, land ownership etc. The particular combinations of grouping which are relevant will depend on the precise context, but if the analysis is conducted at the household level, then it is possible to put together any grouping for which the relevant variables are available from the survey data.

Furthermore, if one wishes to explore non-income "dimensions" of poverty (e.g. educational attainment, remoteness, health etc) and these variables are available in the dataset, then it is possible to present the above tables in terms of deciles of these variables. Table 3 for example, breaks down households' income sources in Nepal by deciles of time to get to the market. It shows for example that income from own enterprises is only of real importance to households who are relatively close to markets, whilst consumption of own production increases as a proportion of total income the further away one is from markets, rising to over half of total income for the most remote three deciles.

There are many different dimensions across which such tables may be constructed. For example, Table 4 shows household income share for each of the 10 geological and economic regions of Nepal along with summary poverty and illiteracy figures for each region. It shows large differences in sources of livelihood between different regions. Income from own enterprises and non-agricultural wages are key in Kathmandu and other

urban areas, whereas in Terai and the Hills and Mountains, own production is the most important source of income. Even within broad geographical regions there are substantial differences: in rural eastern and central Terai almost a fifth of income comes from own enterprises, whereas in mid- and far-west Terai only 4% of income comes from this source. Similarly remittances are key to those living in the rural western hills, but mostly irrelevant to those in the eastern hills.

Table 3: Household income sources by time to market in Nepal

	Deciles of Distance to Market								
Share of Income	**Closest Decile**	**2**	**3**	**5**	**6**	**7**	**8**	**9**	**Distant Decile**
cash wages from working in other's farm	2.1	3.9	8.8	8.1	6.6	7.0	8.9	6.4	5.4
Other wages	18.0	13.8	13.7	15.9	11.2	8.5	8.2	11.6	16.1
Land rent	1.8	0.6	0.7	1.1	0.6	0.1	0.1	0.2	0.1
net agricultural income from sales of crops	1.8	3.7	7.7	10.7	10.2	3.7	6.8	4.4	1.5
net livestock income	1.5	2.0	3.6	3.8	3.9	3.3	3.6	4.1	5.8
net income from own enterprises	48.2	29.7	13.1	7.0	8.2	15.4	5.6	10.1	5.1
total net remittances	7.1	20.3	9.4	5.8	12.7	8.4	14.3	8.6	8.3
other income	8.1	6.0	3.2	1.4	2.9	4.6	2.2	2.6	2.6
consumption of own production	11.4	20.0	39.7	46.2	43.7	49.1	50.4	51.9	55.0
total income	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Baris Sivri – personal communication.

Table 4: Household income sources and poverty by region in Nepal

Share of Income	**Urban Kathmandu Valley**	**Other Urban**	**Rural Eastern Terai**	**Rural Central Terai**	**Rural Western Terai**	**Rural Mid and Far-West Terai**	**Rural Eastern Hills, Mtns**	**Rural Cental Hills, Mtns**	**Rural Western Hills, Mtns**	**Ru Mid a Far-W Hil Mt**
cash wages from working in other's farm	2.4	1.8	10.6	10.1	8.0	10.2	3.6	4.5	6.3	
Other wages	12.6	20.1	12.3	12.3	8.3	9.2	12.4	12.6	9.0	1
Land rent	0.0	1.7	0.9	1.5	0.1	0.6	0.2	0.0	0.1	
net agricultural income from sales of crops (sales-expenditures)	5.6	1.2	17.4	7.9	6.0	15.8	5.1	1.3	2.0	
net livestock income	10.3	2.0	2.4	3.9	3.7	0.5	6.1	3.8	1.9	
net income from own enterprises	40.4	44.5	19.3	17.2	10.9	4.0	5.9	31.2	10.7	
total net remittances (received - sent)	4.3	10.0	6.1	9.8	7.8	4.4	1.1	9.5	22.0	
other income	7.4	7.9	2.0	0.9	2.6	0.6	3.6	1.4	8.3	
consumption of own production	17.0	10.7	29.0	36.4	52.6	54.7	62.0	35.7	39.7	5
total income	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	10
Poverty incidence (%) *	4.0	34.0	42.0	38.0	40.0	53.0	28.0	67.0	40.0	7
Poverty gap *	0.00	0.11	0.10	0.08	0.09	0.13	0.07	0.11	0.13	0.
Illiteracy (%) *	24.0	45.0	62.0	77.0	69.0	72.0	59.0	66.0	54.0	7
Share in Nepal Population (%)	1.4	6.8	12.6	16.2	7.2	6.7	9.7	13.1	13.0	1

Source: Baris Sivri – personal communication.

Constructing such tables can thus give a good indication of how groups of households differentiated by dimensions other than income will be affected by reforms.

Once such tables have been constructed the basic methodology outlined above can be applied to calculate the impact on each household. This has been done using data from several different countries and a wide variety of policy experiments.[13] Table 5 provides an example of a typical set of results based on the simulation of a 10 percent increase in the price of rice in Cambodia.

Table 5: Effect of a 10 per cent increase in the price of rice, by decile, as per cent of total household expenditures, Cambodia

	Decile (*)										
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*TOTAL*
Urban											
Net Sellers	1.9	2.8	3.2	3.5	2.9	2.9	1.7	2.2	1.8	5.7	2.5
Net Buyers	-2.2	-1.5	-1.7	-1.5	-1.5	-1.3	-1.2	-1.2	-1.0	-0.6	-1
Total Urban	-1.3	0.5	-0.4	-0.3	-0.5	-0.1	-0.1	0.3	-0.2	-0.3	-0.2
Rural											
Net Sellers	2.2	2.6	2.4	2.4	2.9	2.8	2.4	2.3	1.4	1.9	2.4
Net Buyers	-1.9	-1.4	-1.1	-1.2	-1.2	-1.2	-1.2	-1.2	-1.0	-0.7	-1.3
Total Rural	-0.4	0.5	0.7	0.8	1.1	1.0	0.9	1.0	-0.1	-0.5	0.6
Net Sellers	2.2	2.6	2.4	2.5	2.9	2.8	2.4	2.3	1.5	3.8	2.5
Net Buyers	-1.9	-1.4	-1.1	-1.2	-1.2	-1.2	-1.2	-1.2	-1.0	-0.7	-1.2
Total	-0.5	0.5	0.7	0.7	1.0	1.0	0.8	0.9	-0.1	-0.4	0.5

(*) Deciles by per capita total consumption
Source: Nicita, Olarreaga and Soloaga (2002)

The results show that the main losers from a rice price increase would be the poorest net buyers in urban areas (because they spend a large proportion of their income on rice), whilst the largest gainers would be the net sellers in the top decile of the urban areas. In rural areas the gains among net sellers are more evenly distributed, but the losses are still concentrated among the poor due to their large expenditure share on rice.

As noted above, there are a large number of different simulations which can be done with the above framework. For example, Ajwad, Duygan and Sivri (2002) simulate the impact of a 25% reduction in transportation costs for farmer households on household consumption in Armenia. They estimate that rural households gain on average 0.95% of total per capita expenditure, compared to 0.1% for urban households, but the gains are reasonably evenly spread among the poor and the non-poor. They also simulate the impact of a 10% increase in irrigation charges; this hurts both urban and rural households by roughly the same extent on average, but poorer rural households are hit much harder than well off rural households because a much higher share of their expenditure is on irrigation. Similarly Ajwad, Aksoy and Sivri (2002) simulate the poverty impact of a 30% increase in tobacco and maize yields in Malawi. The simulated increase in tobacco yields raises incomes of the poorest quintile by 1.5% compared to 0.99% for the top

[13] See poverty chapters of the Diagnostic Trade Integration Studies for Cambodia, Mauritania, Madagascar and Senegal and drafts for Malawi, Lesotho, Yemen and Armenia.

quintile; but raising maize yields has a dramatic impact upon the poor, raising their incomes by 5.66% compared to just 0.5% for the best off.

Applying the basic methodology in this way thus provides a valuable first estimate of the potential effects of a reform. However, the results of such simulations are contentious because they do not allow producers or consumers to respond to changed prices. Possibly more seriously they ignore the role of labour markets; the above simulation must, by construction, give the result that net consumers of a product whose price falls will gain. However, there is some evidence that households who are net consumers of a staple food do not necessarily gain when the price of that food falls if they obtain much of their income from working on farms producing that good, because the reduction in profits for the farm owners results in downward pressure on wages or employment. The next section shows various ways in which the methodology can be extended to address these and other concerns.

4. Extensions of the basic methodology

The above approach to the analysis of the impact of structural reforms on the poor is attractive because its data requirements are relatively low; most reasonable income and production surveys will contain data on quantities produced, inputs used and income received from a variety of different sources.[14] However, it has a number of important weaknesses.

Firstly, the model does not allow for substitution in consumption or production. In reality quantities will adjust (indeed the reallocation of resources may be one of the objectives of the reforms). Resources will shift into the production of goods whose prices have increased, and away from the use of inputs and the consumption of goods whose prices have gone up.

Secondly, the model does not include any markets. Prices are completely exogenous and, unless changed for the purpose of the simulation, remain fixed. Yet in many cases prices will be determined by markets; in particular changes in the demand and supply of labour will determine the real wage of unskilled labour – a key variable for understanding the poverty impact of a reform.

Thirdly, the model does not allow for growth. Yet promoting growth – particularly growth which includes the poor – is often the central aim of such reforms. Allowing the model to incorporate assumptions about growth can be important for simulating medium to long-run impacts.

[14] However, even here there may be difficulties: price information is often not well recorded (often one has to rely on unit prices rather than community price surveys); similarly wage information is often absent so that wages have to be inputed from earnings and hours worked; and transfers data often gives no indication of the source of the transfer (what sector was the person working in) or the determinants of the size of the transfer.

We consider each of these areas below.

Substitution in consumption and production

To allow for substitution in consumption one needs to obtain at least income and own-price (and preferably also cross-price) elasticities of demand. The easiest way to obtain these is to draw them from existing studies of the country of interest. Alternatively, one could attempt to estimate commodity demand equations using one of the standard demand systems (LES, AIDS, AIDADS etc). Ideally time series data on demands for various goods, prices and incomes is needed to ensure a reasonable amount of variation in prices. Alternatively, one may use Deaton's method of exploiting spatial variation in unit prices to estimate own and cross-price elasticities (see Deaton and Grimard, 1992; Deaton, 1997). Nicita (2002) provides an example of the application of this approach to Mexico.

Estimating these elasticities provides a partial equilibrium way of assessing the magnitude of "second round" consumption effects of price reforms. However, estimating such elasticities is not a trivial matter, especially if only cross-sectional data are available. Moreover, it is not clear that incorporating the ability to substitute in consumption is that important. When prices change simultaneously for a large number of commodities, incorporating the ability to substitute in consumption appears in many practical circumstances to make little difference to the overall welfare effects. This suggests that it may only be worth the additional effort of estimating such elasticities if one has a particular reason for believing that consumption substitution effects are likely to be important. On the other hand, if reasonable consumption elasticities are already readily available from other studies, their incorporation within the above framework is straightforward (see below) and there is no reason for not doing so.

To allow for substitution in production one could attempt to estimate output supply or factor demand equations. As with estimating consumption demand systems, this requires one to make assumptions about the functional form of the output supply/factor demand functions, and there must be a reasonable amount of variation in prices in the data. Again the easiest approach is to draw the resulting supply elasticities from existing studies. If these are not available then time series data is needed on outputs, prices and factor demands. Alternatively, one may attempt to estimate elasticities by combining cross-sectional and time-series data (see Mundlak (1963)), but estimating such elasticities solely from cross-sectional data is particularly difficult for agricultural production because natural conditions also cause large variations in supply. Furthermore, estimates of supply functions tend to assume smooth substitutability between the production of different commodities whereas in fact the major welfare changes may occur when markets are created or destroyed as a result of reforms. Such discontinuities are not generally captured in traditional supply systems.

Does the incorporation of such supply elasticities matter? In the short-run it may be reasonable to suppose that changes in the activities undertaken by households may be relatively slow (certainly compared to changes in consumption), so that the short-run poverty impact may justifiably assume fixed quantities of production. However, data from numerous countries suggest that households tend to be much less diversified in production than in consumption, so that reforms which change the returns to different activities are likely to have much larger welfare effects than reforms which change the prices of goods which households consume. Certainly, long-run supply response is critical to long-run poverty alleviation, so the incorporation of long-run supply elasticities in calculations of the poverty impact is probably much more important in most cases than the incorporation of consumption elasticities.

Even if it is not possible to estimate a full supply or demand system, it may still be worth incorporating reasonable estimates of the own-price demand and supply elasticities for the goods which are subject to price changes since a range of plausible values is more likely to reflect reality than assuming that all elasticities are zero. These elasticities may be easily incorporated within our simple framework by amending equation (1). Each element of equation (1) consists of an income or budget share (IS_j or BS_j) multiplied by a percentage price change ($\Delta p_j / p_j$). Incorporating price elasticities into this equation simply involves replacing each $BS_j.(\Delta p_j / p_j)$ term with

$$BS_j.\frac{\Delta p_j}{p_j} + \frac{1}{2} BS_j \left(\frac{\Delta p_j}{p_j} \right)^2 \varepsilon_j \qquad (2)$$

where ε_j is the relevant own-price demand elasticity for good j (and similarly for the income share terms and the own-price elasticity of supply).[15]

Modeling the labour market

Assuming that quantities remain fixed (and therefore that only wages adjust) is especially problematic for the labour market since it is equivalent to assuming a labour supply elasticity of zero. In reality the price and cost changes induced by reforms will make some activities more profitable and others less so; demand for labour in the benefiting sectors will rise increasing both employment and wages, whilst demand in the losing sectors will fall reducing employment and wages. If adjustment is smooth and instantaneous then there will be no net effects upon employment and the effect on wages of different types of labour will depend on the relative intensity with which they are used in the gaining and losing sectors. However, in many circumstances adjustment is far from smooth or instantaneous. Companies losing from reforms may simply be unprofitable

[15] The superscripts from equation (1) have been omitted since this expression applies to all elements of that equation (except remittances). See Minot and Goletti (2000) for a derivation.

and close, shedding large numbers of jobs; if employment in the affected sector dominates the local economy then this can have large negative externalities on other businesses. Enterprises in the sectors gaining from reforms may be located in different places and draw upon a different pool of labour. Thus although the national aggregate of employment may be little affected by reforms, local effects can be considerable and longer lasting.

The opposite extreme from assuming a zero wage elasticity of labour is to assume that it is infinitely elastic implying that, if a sector expands, employment tends to rise rather than wages. In some sectors and countries this may be nearer the truth than assuming a zero elasticity (the empirical evidence is mixed – see the survey by Matusz and Tarr (1999); Winters (2002) presents evidence that employment adjusted more than wages in India during the 1990s). In practical terms it may be sensible to take into account the segmented nature of many labour markets in developing countries, since the simplest assumption of an infinitely elastic labour supply suggests somewhat unrealistically that the "wage" when out of work is exactly the same as the wage in employment. It may be better to assume that employment expands in the gaining sectors at the existing sector or location specific wage.[16]

If we assume that employment expands at a fixed sector specific wage and wish to simulate the impact of an increase in demand then we need a way of moving people into and out of jobs. It is clearly rather unrealistic to suppose that all of these new jobs will be filled from the ranks of the previously unemployed; in many cases people will switch from one job to another in order to take advantage of the differences in sectoral wage rates. Nicita et al (2002) provide a useful approach to calculating who is likely to gain from an expansion in employment. They calculate the probability of being in different forms of employment using a multinomial logit, rank households according to these probabilities and then put them into jobs in the order of their probability. This approach fits nicely with the intuition that, when formal sectors grow it is often not the poor who get the jobs, or at least not at first. In addition, if the new wage "allocated" to a household on getting a job is determined by a wage equation which takes into account sectoral wage differentials then it will be possible for there to be discrete changes in income when a person gets a job.

This approach has been applied in the Integrated Framework studies for a number of different countries. For example, the study for the Republic of Yemen (2002) simulates the impact of a 6 percent increase in female participation in the labour market. Since poorer households are more likely to participate in the labour market in Yemen, two-thirds of the households affected by the increase in employment opportunities are in the bottom three expenditure deciles. Furthermore, the average impact for those households that have a new entrant to the labour force is equivalent to 30 percent of total household expenditures. Similarly in Malawi, Ajwad, Aksoy and Sivri (2002) simulate the poverty impact of a 30% increase in employment in manufacturing, construction and mining.

[16] Or at least that the formal sector wage is higher than the subsistence wage.

Because of the characteristics of those employed in these sectors they find that this large increase in employment has no effect upon the poorest quintile, whilst the richest quintile gains by 4%. In Cambodia, Nicita, Olarreaga and Soloaga (2002) show that the impact of an increase of 50,000 employees in the industrial sector would have a large positive impact on rural households in the lowest expenditure decile with at least one member switching to the sector. But because of the relative probability of obtaining such jobs, the overall benefit to rural households is lower than the gain experienced by urban households.

A similar but somewhat more sophisticated methodology is used by Bourgignon and others in micro-simulation models of distribution changes (Bourguignon, Fournier et al. 2000). Bourguignon et al. estimate an individual level wage equation correcting for selection bias using the Heckman method. They then estimate wage and farm labour participation equations sequentially for each member of the household (starting with the household head) as a multinomial logit choice between (i) inactivity (ii) wage work (iii) work on the family farm (iv) work in non-farm businesses and (v) a combination of (ii) & (iii). The multinomial logits incorporate variables reflecting household characteristics which may have an influence upon individual participation decisions.

The advantage of both of the above methods of modelling employment and wage income is that they only require readily available household survey data. In particular all that is needed is information on employment by sector, wages (or employment income and the quantity of labour supplied) and household characteristics. Using only this information it is possible to "allocate" individuals to jobs and determine their likely wage, given a known increase or decrease in employment. However, the extent of the employment change is exogenous using the above approach. Ideally, the expansion or contraction of each sector resulting from reform could be predicted by a general equilibrium model, but, as noted above, the resources required to construct a CGE model may preclude this option in many countries. One therefore needs a mechanism for estimating the potential employment impact of a structural reform. There are two components to this problem: firstly, it is necessary to estimate the impact of the price change induced by reform on sectoral output; and secondly it is necessary to estimate the impact of the change in output upon employment and wages.

One ad hoc approach to the first part of the problem would be to use investment climate surveys to obtain estimates from senior managers of companies in each sector about the sort of growth rates they anticipate and what difference they might expect policy reforms to make. Such estimates are of course highly subjective at an individual level, but assuming that knowledge of the prospects for growth is reasonably common across each industry, aggregate estimates of growth expectations may be at least as accurate as historical or model based estimates. Furthermore, if detailed firm-level surveys are available it may be possible to cross-check whether growth expectations are "reasonable" given the margins and financing structure of firms within the industry.

Alternatively, if estimates of aggregate supply elasticities are available, then these may be used to estimate the impact of price reforms on the output of affected sectors. By its nature this approach will not take into account general equilibrium effects, but if the reforms do not affect too many sectors simultaneously then this may provide an adequate approximation of the output change.

Estimating the impact of the change in output upon employment and wages can be addressed in a number of ways without resorting to a CGE analysis. If the sector of employment is indicated in the household survey, then it is possible simply to scale employment up or down by the sectoral growth rate (if one is assuming an infinite elasticity of labour supply) or to scale wages up or down for existing employees (if one is assuming that the labour supply elasticity is zero).

If it is reasonable to assume excess capacity and unemployment so that exogenous changes can be satisfied through an increase in output without having any effect on prices, then a slightly more theoretically defensible approach is given by Niimi, Vasudeva-Dutta and Winters (2002). They attempt to estimate the employment impact of the growth in exports and imports in Vietnam between 1993 and 1998 using the Vietnam Input-Output matrix. They simply calculate labour coefficients for each sector (in terms of jobs per $ of output) by dividing the total labour cost in each sector by the value of gross output (to give labour cost per $) and then dividing by the average wage.[17] Using this approach one can simulate the employment impact of any assumed sectoral growth rate by simply multiplying the change in output by the labour coefficient for the sector. For example Niimi, Vasudeva-Dutta and Winters (2002) multiply the labour coefficient for each tradable sector by the change in exports to calculate the addition employment created by the expansion of exports. Similarly the employment "destroyed" by the expansion of imports was calculated by multiplying the labour coefficients by the changes in imports. This approach provides a lower bound of the employment changes resulting from growth.[18]

Simply using the labour coefficients from the I-O matrix assumes that there are no second-round expenditure effects associated with the demand for intermediates (or that all intermediates are imported). Where the production of intermediate inputs is an important part of the local economy one may wish instead to use "total labour coefficients" which take into account the effect of growth on the demand for intermediates (see Niimi, Vasudeva-Dutta and Winters, 2002).[19] This provides an upper bound of the employment changes. Of course the lower and upper bounds are rather crude approximations to the employment changes, but the advantage of this approach is that it only requires an Input-Output matrix (and preferably information about sectoral wage rates).

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[17] Ideally the average sectoral wage should be used, but in their case this was unavailable.

[18] Assuming no changes in wages.

[19] This is similar to the technique of using Social Accounting Matrix (SAM) multipliers to simulate the impact of exogenous income shocks upon different household groups – see Decaluwe, Patry, Savard and Thorbecke (1999) for an excellent exposition.

Analysing Remittances

Finally, in many countries remittances form an important part of income for many groups of households. If this is the case then one needs to think about the determinants of remittance income since it is not satisfactory to treat them as exogenous. There are a number of ways in which this might be done. At the very least, if one has estimates of the sectoral growth rates likely to result from reform (or a set of scenarios about what such growth rates might be), and if the sectoral source of the remittance is indicated in the data, then it is straightforward to scale up or down household remittance incomes accordingly. This is similar to the inelastic labour supply assumption above in that it is assumed that the wage rises in the growing sector benefiting existing employees and therefore increasing remittances. To account for the idea that growing sectors will employ new people who may then remit income it may be better to estimate the probability of receiving remittances from different sectors and the level of remittance received/sent against a set of household characteristics (see Republic of Yemen (2002) for an example). Then one can scale up or down employment in the different sectors using the probability of involvement in exactly the same way as suggested for labour income above.

This simple approach does not take into account the fact that whether households have remittances often depends on an earlier decision by one or more household member to migrate in search of work. If data are available on sectoral employment and wage rates as well as the characteristics of those employed, then it is possible to adopt a somewhat more sophisticated approach by modeling the decision to migrate. Consider a simple model of a household with n adult members – n^r are in the rural household (which is receiving the remittances), n^u are in the urban area sending remittances. For simplicity say that the members in rural areas are guaranteed a return on their labour of w^r, whereas those in the urban area may receive a higher return w^u but with a probability that depends upon overall labour demand and their individual characteristics. Assume each household maximizes its household income (i.e. the total income of its members in both the rural and urban areas).

In this simple model, maximizing income simply involves deciding how many people to send to the urban area to try and get a job. If the sectoral wage and the way in which the probability of getting a job depends on characteristics is known, then each household can allocate the optimal number of people to finding employment in the urban area. In the case of households with members with "poor" characteristics, it may not be worth their while sending someone to get a job, but if, for any household member w^u.Prob(Employment) > w^r, then sending that member to obtain employment will increase expected household income, and, if the household is risk-neutral, its welfare. Finally, if a household does send one or more members to the urban area to obtain employment, then one has to determine how much remittance income they will send back. One approach is to assume (or calculate from the data) an average saving rate and assume that they remit a fixed proportion of their income. An alternative might be to

assume a "social compact" within the household that the migrant would not live at a higher per adult equivalent level of consumption than the members of the sending household i.e. that they would remit that amount which would make them as well off as the receiving household (after taking into account the remittance).

If one were to exploit a simple "Harris-Todaro" model of this kind, estimating the returns to different activities and the parameters of the probability of employment from the data, then it should be possible to simulate the impact of growth in a particular sector upon the supply of migrant labour and therefore upon the level of remittances, whilst taking into account the loss of income resulting from their departure from rural areas. Annex 2 elaborates on the simple model and describes how this might be implemented in practice.

Modeling the Household

The sections above have described ways of separately incorporating quantity responses into each element of income and consumption i.e. production and consumption substitution, expansions or contractions of labour employed, and shifts in remittance income. However, in practice these responses happen simultaneously within the household. It would be useful therefore to have a mechanism for modeling the impact of price changes upon households when they are allowed to simultaneously respond by changing production, consumption and labour sale decisions to maximize their overall welfare. This suggests the use of simple "household models" in the Singh, Squire and Strauss (1986) tradition. Such models assume that households are faced with an exogenous set of prices but can re-allocate their resources between different activities to maximize overall household welfare. IFPRI have developed a sophisticated non-separable farm household model (Lofgren and Robinson, 1999) to explain non-linearities in the supply response of households to a variety of policy reforms. Their approach is quite data and resource intensive. However, it is possible to construct a very simple version of their household model which allows one to take account of household level responses. Consider the following simple model:

Equation	**Example**
1. Utility	$U = \prod_i \left(q_i^C\right)^{\alpha_i}$
2. Production function	$q_i^X = a_i \cdot \prod_f \left(qf_{fi}^I\right)^{\beta_{fi}}$
3. Commodity balance	$q_i^X + q_i^P = q_i^C + \sum_j q_{ij}^I + q_i^S$
4. Factor balance	$qf_f^E + qf_f^P = \sum_i qf_{fi}^I + qf_f^S$

5. Cash constraint $$\sum_i p_i^P q_i^P + \sum_f p_f^P qf_f^P = \sum_i p_i^S q_i^S + \sum_f p_f^S qf_f^S$$

Say that a household maximizes their utility (given here by a simple Cobb-Douglas function of the goods which they consume) subject to a set of constraints. The first constraint is the production technology which they have (given above by a simple Cobb-Douglas function of the primary factors); the next two constraints are simple commodity balances – the quantity of any commodity produced plus the amount purchased must equal the amount consumed plus the amount used as inputs and that sold – similarly the total endowment of a factor which the household may have plus that which is purchased (e.g. labour hired in) must be equal to that used in production and that sold; finally, the household is subject to a cash constraint so that its total purchases of commodities and factors cannot exceed the value of its sales of commodities and factors.[20]

Given a set of exogenous purchase and sales prices for commodities and factors (if necessary unit prices from the household survey may be used), households will choose how to allocate their factors between different activities in order to maximize their incomes, consumption and utility. The model requires a small set of parameters (the a_i, α_i, and β_{fi} for each commodity i and factor f) which can either be taken from existing studies or estimated from the data. It is therefore possible in principle to construct a "household level" SAM for each household in the dataset and to estimate the impact of a price shock on household behaviour for each household separately.

Table 6 gives an example of a simple stylized household SAM. This household undertakes two activities –subsistence crop production and cash crop production. These activities use labour, land and capital as well as fertliser. These activities "sell" their output to the commodity accounts (SUB-C and CASH-C) respectively. In addition the commodity accounts "import" some of the subsistence crop from the "Rest of the World" (recall that this is a Household level SAM so that the Rest of the World (ROW) here simply means all other households; "imports" in this context are simply purchases from outside the household) as well as fertliser and non-food commodity. The household also sells their output of the cash crop to the ROW – their cash constraint means that the value of their imports (subsistence crop, fertiliser and non-food) must match the value of their exports (cash crop). The household's endowment of labour, capital and land "pays" the household account which then spends its income on food and non-food.

In a practical example the household may have many more activities and there will be many more commodities. In addition, if the data allows, factors of production can be broken down (e.g. by gender, age, experience, education etc). The model may also allow some factors to be tradable (e.g. labour) whilst others may not be (e.g. land). More significantly, the determination of whether a commodity or factor is tradeable can be endogenous. Our model allowed the possibility of differences in the purchase and selling

[20] For simplicity we have set up the commodity and factor balance constraints and the cash constraints as equalities – it is possible to specify them as inequalities so that not all factors or commodities have to be used.

prices arising from transaction costs. This can result in households choosing not to trade goods which, were such transaction costs reduced they would trade.[21]

It may not be realistic to construct a full household level SAM for every household in the dataset (although this is not impossible – indeed Cogneau and Robilliard (2000) and Robilliard, Bourguignon et al. (2001) have embedded all the households in the survey into a full country level CGE). However, it is relatively straightforward to construct a set of SAMs for "representative households" and estimate the impact on each of these representative households separately.

The household modeling approach has the attraction that it can allow for all the above substitution effects within a consistent theoretical framework, whilst only requiring information typically available from a household survey. However, it has the important disadvantage of remaining a fixed price model. Indeed it is perfectly possible for each of the representative households simulated to simultaneously supply more labour to the market as a result of a structural reform without this having any effect upon the wage. Similarly household production responses change the supply and demand for commodities in the economy, but, in these household models this has no effect upon the prices of these commodities. In some circumstances this does not matter – if prices are likely to remain fixed or if the nature of the changes can be assumed exogenously then it is not necessary to complicate the model by incorporating assumptions about the ways in which markets clear and prices adjust. However, in other circumstances accounting for the likely changes in the prices of some key commodities (notably staple foods) and some key factors (notably the unskilled wage) is important. One way in which these can be accommodated without moving to a country level CGE model is to employ a multi-market model.

[21] More precisely, production and consumption decisions become non-separable so that the household is in fact responding to an endogenously determined shadow price rather than to the market prices.

Table 6: A Stylised Household SAM

		Activities		Commodities				Factors			Household	ROW	Total Supply/Income
		1	2	3	4	5	6	7	8	9	10	11	
Activities		SUB-A	CASH-A	SUB-C	CASH-C	INPUT-C	NONF-C	LAB	CAP	LAND	HH	ROW	
1. Subsistence activity	SUB-A			40									40
2. Cash crop activity	CASH-A				75								75
Commodities													
3. Food crop	SUB-C										60		60
4. Cash crop	CASH-C											75	75
5. Fertiliser	INPUT-C	10	20										30
6. Non-food	NONF-C										25		25
Factors													
7. Labour	LAB	10	20										30
8. Capital	CAP	10	20										30
9. Land	LAND	10	15										25
Household													
10. The household	HH							30	30	25			85
Other institutions													
11. Rest of the World	ROW			20		30	25						75
Total Demand/Expenditure		40	75	60	75	30	25	30	30	25	85	75	

Expenditures go from column to row (or equivalently, sales go from row to column). The row totals therefore represent the income of each account; column totals represent total expenditures of the accounts.

Multi-Market Models

All the above assumes that prices are exogenous. In some circumstances this may be reasonable – such as homogenous tradeable goods whose price will be determined by the world price. But the literature on growth linkages (Haggblade, Hazell et al. 1989; Hazell and Haggblade 1991) points clearly to the fact that many of the goods which matter to the poorest people are non- or at least not very readily tradeable. In such situations prices are going to be determined by local market clearing.

Multi-market models model the impact of household supply and demand decisions upon the prices of key commodities and thereby on household income (see Braverman and Hammer (1986) for an early exposition; Arulpragasam and Conway (2002) provide a practical guide to the use of such models). Rich and Lundberg (2002) describe the application of a multi-market model to the analysis of policy reforms in Malawi. Their model contains explicit supply and demand equations for a limited set of commodities using supply and demand elasticities estimated from previous studies. However, the key difference from the household model above is the inclusion of a set of price equations linking domestic producer and consumer prices for each commodity with import and export prices given estimates of various transport and transaction costs and taxes. Producer and consumer prices are then made endogenous by the inclusion of a market clearing equilibrium equation which ensures that the overall supply and demand for each commodity is equalized. Household agricultural income is determined by the value of the commodities produced by each of four household types minus their costs of production; non-agricultural income is exogenous to the model.

Minot and Goletti (2000) present an interesting variation of this approach by constructing a spatial multi-market model for Vietnam. This is similar to the model of Rich and Lundberg but with a number of innovations. Most significantly they estimate supply and demand elasticities for several different regions of the country, rather than for different household groups. Markets in their model follow rules of spatial arbitrage – that is, trade between two regions occurs when the price difference between them reaches the transfer cost (the full cost of transporting and marketing the good from one region to the other). The model generates estimates of the impact of changes in transaction costs and export quotas upon production, consumption and prices of a set of commodities as well as average incomes in each region. In order to estimate the distributional and poverty impact of these changes, the price changes predicted by the model, along with the estimated supply and demand elasticities, are applied to household data on production and consumption to predict the change in net income for each household using the basic methodology described above.

Multi-market models are a useful tool for the analysis of reforms if those reforms are likely to give rise to supply and demand responses which may significantly change prices. However, multi-market are heavily dependent on being able to obtain reasonable

estimates of income and price elasticities of demand and supply elasticities. Furthermore, multi-market models, like the household model described above, have no factor markets (indeed, unlike the household model above, they have no factors at all since income is determined by the value-added of own production). It is therefore impossible to examine the impact of supply and demand responses on the wage. Indeed non-agricultural income is often exogenous and models where this is the case are clearly not appropriate for the analysis of situations in which non-farm income is important. Given that the consumption of non-tradable services in rural areas can be extremely important (Hazell and Hojjati 1995) this is a particularly serious omission, although there is no reason in principle why non-tradable services cannot be added as a commodity within a multi-market model if suitable data are available. Nonetheless, multi-market models can be valuable if endogenous price changes resulting from responses in several different markets is likely to be the main driver of welfare changes.

Allowing for Growth

The omission of growth from the basic methodology is a particularly serious omission because the size of the impact on poverty resulting from a typical simulation which does not incorporate growth tends to be rather small. Consider a large shock such as a 50% increase in the price of rice in Cambodia. Table 1 shows that rice production is 21.4% of the income of the poorest decile; Table 2 shows that rice consumption is 28.4% of their expenditure – thus their net consumption of rice is 7% of their income. Thus the percentage change in net income of the poorest decile when faced with this large shock will be at most 3.5% of their net income (7% times 50% price change). Furthermore, if poor households are able to adjust at all, either by producing more rice or consuming other foods, then the impact on their net income will be less. Of course this is an aggregate figure – individual households or groups of households may be more severely affected – but the fact remains that the aggregate impact (positive or negative) upon the poor from such simulations tends to be rather small.

The generally small value of predicted impact is in direct contrast with the claims of two different actors in the process of reform. Activists, NGOs and organizations representing those most severely affected often claim that the negative effects from structural reforms are large; whilst governments and international organizations often claim that the benefits from such reforms are large. These differing perspectives can be understood when one allows for aggregation and growth (Kanbur, 2001). For example, claims of strong negative effects on some groups are often true – some households or groups can be badly hit by particular reforms – but when the impact on such groups are aggregated along with the smaller negative or positive impact on other households the overall effect can be quite small. Resolving this is a political rather than an economic issue – policymakers need to decide on the extent to which policy should be determined by its impact on the worst affected as against the impact on the general population. Claims of strong positive effects from structural reforms usually rely on (sometimes correct) assumptions about the impact of reform on growth. In the medium to long-run the impact of enhanced productivity and

growth on poverty tend to dominate the impact of redistribution caused by reforms (see Demery, Sen and Vishwanath, 1995), and poverty can be substantially reduced if reforms actually do have the assumed impact on growth.

How might one incorporate growth within our simple methodology? In the absence of a model linking policy reform to sectoral growth rates one is forced to rely upon projections based upon historical performance. It is straightforward to incorporate a steady reduction in particular transaction costs, or productivity growth in line with that experienced in the past (see World Bank (2001)). Furthermore, if separate studies give some indication of how such parameters may be changed by policy reforms then these new values may be used instead. Certainly this approach leaves much to be desired, but it does have the advantage that, since the "growth" rates are exogenously determined, it is possible to conduct sensitivity analysis so that policymakers can see the likely distributional outcome for any set of growth rates which they deem to be plausible.

5. Other Ideas for Methodological Development

In the longer term there are a number of other ways in which the analysis of the linkages between structural reforms and poverty could be improved. I have grouped these under two themes: dynamics and risk; and qualitative approaches.

Dynamics and Risk

Poverty is not a static phenomenon. A large number of studies from both developed and developing countries show that there is a great deal of movement in and out of poverty (see Baulch and Hoddinott (2000) for a selection of papers on poverty dynamics in developing countries). However, much "poverty profile" analysis is based upon static regressions between income/consumption and a set of household and economic characteristics. Unsurprisingly we find that the poor have high dependency ratios, are poorly educated, have few assets and live in poor areas – in other words, they are poor! However, the policy implications resulting from such associations are much less clear: "removing" children or the elderly from households with high dependency ratios is not a policy option; neither in most cases is supplying significant private assets to poor households, while the problems associated with "moving" households to better areas are well known. Education *is* a key policy option, but even here, it is not certain that, if everyone's educational level rises, the poor will be much better off, even if they are better educated.

Interventions based upon such static analysis may therefore be less effective than expected in reducing poverty. If, instead we think of poverty as a dynamic process, then the "equilibrium" poverty rate can be reduced either by reducing the probability of falling into poverty, or by increasing the probability of exiting poverty (or both). For example, if

the most important reason why households fall into poverty is illness of a major income earner in the household, then appropriate primary (and curative) health care can be prioritized; similarly if the principle reason for exiting poverty is obtaining a job, then employment creation can be emphasized. It is therefore important that poverty analysis should attempt to understand the most important reasons for falling into and exiting from poverty. In particular, it is important for us to know the extent to which price reforms are a cause of entries into or exits from poverty.

How might this analysis be done? When there is only one survey available for a country there is little that can be done. This said, it is astonishing that household surveys in addition to collecting large quantities of quantitative data about the *status* of the household don't also ask the simple qualitative question "what happened?". Households that have fallen into poverty usually know why - analysis of this qualitative information would be extremely valuable and it is important that future surveys conducted should provide for a mix of quantitative and qualitative information about causality.

In some situations we do have more than one survey – usually for different years, but sometimes within year. In this situation there is a lot that can be done. Where the multiple surveys are repeated cross-sections, these are typically used to look at aggregate trends in poverty. However, they also offer the possibility of understanding something about the dynamics of poverty by examining pseudo-panels. For example, one might look at how different cohorts have fared, possibly disaggregated by region, sector or skill (see Deaton (1997) for a discussion and application of the methodology). Although the extent of disaggregation may be limited by the need to maintain reasonable standard errors, such analysis can be very useful in painting a picture of how different groups in society have actually fared as a result of known price shocks. Credible explanations of what has actually happened in previous reform episodes can be more convincing to policymakers than simulations based upon single snapshots in time.

Furthermore, in a handful of cases panel data is available. In these situations much more comprehensive analysis of the impact of economic reforms is possible. The classic methodology is outlined by Dercon (2000) for Ethiopia. But panel data sets are available and have been analysed for Peru (Glewwe and Hall 1998), Zimbabwe (Alwang, Mills et al.; Hoddinott, Owens et al. 1999), South Africa (Carter and May, 2001), China (Jalan and Ravallion 1998), India (Walker and Ryan 1990), Pakistan (McCulloch and Baulch 2000) and Vietnam (Niimi, Vasudeva-Dutta and Winters, 2002). In other cases intra-annual panels may be available (i.e. the same households were recorded at multiple times during the year, but households are different across years). Thus, in addition to exploring how poverty has changed between years, using the intra-annual data to "correct" for seasonality, it may be possible to analyze how seasonality itself moves people into and out of poverty within the year. Seasonality is well documented as one of the most important concerns of the poor (Narayan, Chambers et al. 2000) and since the seasonality of price variation arises precisely because of the lack of suitable behind-the-border trade institutions and policies (warehouse receipting systems, buffer stocks, etc), understanding

the way in which these price changes impact upon poverty can give valuable insight into the poverty effectiveness of behind-the-border trade interventions.

Closely related to the issue of poverty dynamics and the impact of shocks is the issue of risk and uncertainty. Sometimes economic policy analysis ignores the substantial risk aversion of poor households. However, providing security is a central pillar of the WDR 2001 approach to poverty reduction. The reason is quite clear; poor households not only have less – they are much more vulnerable to being in poverty in any given year. They consequently make great efforts to minimize this vulnerability and these efforts can undermine their ability to benefit from reforms and their long-run growth. For example, poor households sometimes plant lower yielding but more drought resistant crops despite the fact that they could substantially increase their incomes with higher yielding crops if they had an effective means of dealing with the risk of crop failure. Thus tackling issues of risk and vulnerability in the analysis of structural reform and poverty helps to link such reforms more closely to the social protection policies which form a key part of many PRSPs.

There are a number of ways in which an analysis of risk may be undertaken. Firstly, in many cases surveys record both consumption and income. In cases where there is just one survey it is useful to look at how much narrower the cross-sectional consumption distribution is than the income distribution.[22] Where a panel (or pseudo-panel) is available it is possible to calculate the extent of consumption smoothing as well as the degree of persistence in both consumption and income. Studies which have done this have shown that the poor are, unsurprisingly, rather less well insured than the better off (Jalan and Ravallion, 1999). However, this begs the interesting policy question - what sorts of interventions are likely to affect the vulnerability of households to poverty, given that domestic institutions can be important indirect providers of social protection (e.g. agricultural marketing boards which provide guaranteed prices, or enterprises providing transfers to existing and former employees). In order to answer this question it is necessary to have a measure of vulnerability. Several people have constructed vulnerability measures (see Christiaensen and Boisvert 2000; Pritchett, Suryhadi et al. 2000; McCulloch and Calandrino 2002) and then attempted to understand the determinants of vulnerability. An analysis of how reforms affect vulnerability could therefore enrich the analytical framework used above.

A second, more comprehensive approach to incorporating risk into our analysis, would be to incorporate a stochastic element into the household modeling approach discussed above. Household models provide solutions for the optimal allocation by households of the productive factors at their disposal. Including risk in such models would allow one to capture the idea that households tend to allocate resources in order to maximize the return to and minimize the risk from their entire "portfolio" of activities.[23] Such a model would

[22] Although the difference will be a mixture of consumption smoothing and differences in measurement error variances between consumption and income.

[23] More precisely one might model them as maximizing their expected utility taking into account their risk aversion.

allow one to simulate the impact of reforms which changed the volatility of prices. For example, the removal of a variable rate tariff is likely to create greater domestic price volatility than previously (along with a change in the average price). A model which incorporated risk could analyse the impact of *both* these effects upon poverty and vulnerability.

Qualitative Approaches

The above discussion has focused on technical economic methodological issues. However, as WDR 2001 stressed, poverty is about much more than just income and consumption so it is essential to take a multi-dimensional approach to poverty analysis. A multi-dimensional approach does not necessarily mean a qualitative approach; other dimensions of poverty can be quantified and analysed using the same tools as those applied to income and consumption. For example, there is no reason why one cannot report educational level, access to medical facilities, distance from markets, extent of soil degradation etc by decile or plot their cumulative distributions just as is done for income and consumption. Furthermore, several surveys contain subjective measures of wellbeing and almost all surveys contain information on assets and durables enabling the construction and comparison of welfare indices based on these variables (see Sahn and Stifel (2000) for an example using the Demographic and Health Surveys in Africa).

However, aside from the technical literature, there is a vast amount of qualitative literature on poverty and the impact of reform on poverty in developing countries. Such material does not have the advantages of quantitative surveys in terms of providing a statistically representative picture of a whole country. But it can provide enormously valuable insights into the processes of destitution, the structural social relationships which provide the context in which economic activity takes places, the nature and functioning of key institutions, the dynamics of intra-household and community behaviour, the political processes which determine the success of reform, and much more. Of particular importance is the role which qualitative studies can place in uncovering the causal pathways through which reforms may influence different dimensions of wellbeing. For example, if a reform increases the price of a cash crop typically produced by women, but social norms dictate that women are also responsible for household maintenance and childcare then the reforms may simultaneously increase incomes and reduce the welfare of poor women due to the additional pressures on their time. Quantitative household surveys rarely capture such processes making it important to perform analysis using both quantitative and qualitative sources.[24]

One key resource here is the large volume of participatory material which is now available on many countries. In situations where quantitative surveys are of debateable quality, such participatory analyses can provide key information on the relative

[24] See (Kanbur, Chambers et al. 2001) for a collection of notes on mixing quantitative and qualitative approaches.

importance of different sources of income to different groups within the society. Also, although it is difficult to obtain good measures of the *level* of welfare from participatory assessments making comparisons across groups difficult, such exercises do generally provide useful indications of the direction of *changes* in welfare over time. They can also provide information about: the key causes of poverty; the dimensions of poverty which matter to the poor in that country; the nature and extent of the risks faced by the poor; the policies and institutions which have the largest impact upon their lives; the role and timing of seasonal shocks; the agro-climatic conditions faced by different groups and so forth. They can therefore provide a valuable input into the analysis of the impact of structural reform on poverty.

Summary and Conclusions

This paper has outlined a simple methodology for linking structural reforms and poverty using household survey data from developing countries. As is always the case, the nature of the appropriate model for analyzing such linkages must depend upon the precise question being asked and upon the data and time resources available. If the intention is to analyse the short-run impact of exogenous price changes, then the basic methodology, which assumes that all quantities remain fixed, can be used to provide a first-order approximation to the likely change in net income for each household. Furthermore, if the nature and size of the transport and transaction costs determining producer and consumer prices are known then it is possible to simulate the impact of exogenous changes in these costs.

If it is desired to look at the medium run outcome of such exogenous policy changes then it is necessary to account for the possibility of substitution in both consumption and production. Ideally this should be done by the econometric estimation of price elasticities of supply, and income and price elasticities of demand if suitable data are available. If this is not possible within the available time or data constraints, then estimates can be selected from other studies of the same or "similar" countries, or, at worst, parameters can be chosen which reproduce the observed output levels given an assumed functional form. Experience from several countries suggests that many households tend to be more specialized in production than in consumption, so that the incorporation of substitution possibilities in production has a greater impact upon the final results than the incorporation of substitution in consumption.

In many circumstances, households earn an important share of their income from the labour market. The basic methodology's assumption of fixed quantities may not always be appropriate here, since exogenous price shocks resulting from reforms may give rise to changes in employment levels in different sectors rather than only changes in wages. If excess labour means that it is reasonable to assume that employment can change without changes in wage rates and the sector of employment is indicated in the household survey data, then employment can be scaled up or down by the sectoral growth rate.

Alternatively, labour coefficients from an input-output matrix may give an indication of the employment changes resulting from exogenous changes in output.

If employment changes can be calculated or assumed, then it is still necessary to allocate (or take away) the jobs to individuals. Here it is possible to draw upon the household survey data to estimate the probability of an individual being employed in a variety of different activities based upon their characteristics and those of their household. In this way one may account for the fact that the growth resulting from a reform may not directly benefit the poor if there is no corresponding rise in the unskilled wage.

Similarly, in circumstances where remittance income is important it may be desirable to have a somewhat deeper analysis of the impact of reform from this source. If estimates are available for the sectoral growth rates likely to result from the reform and the sector source of remittance income is known then it is possible to scale up or down household remittances pro-rata. Alternatively, one may estimate the probability of receiving remittances based upon household characteristics and increase or decrease employment (and therefore remittances) on this basis. Better still, if suitable data are available, it may be possible to model the decision to migrate based upon the expected remittance returns and then simulate the change in income resulting from a shift in the probability of employment in particular sectors.

One may also attempt to integrate the above extensions of the basic methodology in the form of a simple household model. Such a model can allow a household to allocate their resources between a number of different activities (including wage labour) in order to maximize their utility when faced with an exogenous set of prices. One can then simulate the manner in which households change their resource allocations when prices change as a result of reform.

Alternatively, if reforms are likely to give rise to supply or demand responses with significant knock-on effects for domestic prices, then it is possible to endogenise the process of price formation through the use of a multi-market model. However, such models can require substantial additional data and resources and are often inappropriate for analyzing circumstances where non-agricultural income is important.

Other potential methodological developments include greater attention to the dynamics of poverty and the ways in which reforms may cause entry into or exit from poverty. Furthermore, with suitable data it may be possible to simulate the impact of structural reforms on price volatility and the consequential impact upon household vulnerability.

Efforts may also be made to analyse the quantitative aspects of non-income dimensions of poverty. However a proper analysis of the linkages between reform and other dimensions of poverty will require an exploration of the qualitative poverty material in each country.

All of the approaches described above have focused on ex ante prediction of welfare effects resulting from structural reforms. This is, of course, what policymakers are most

interested in. However, it is worth noting that ex ante analysis can also be usefully informed by the application of the same techniques ex post to see if the predicted effects actually did occur. Such ex post analysis can point to weaknesses in the modeling methodology and provide information on the relative importance of different effects upon welfare, allowing future modeling to take these into account. More generally, it is important that the effects of structural reform are monitored during implementation and adjustments made if it becomes clear that the predicted and actual effects are far apart.

In conclusion, the choice of technique for modeling the link between structural reforms and poverty should be determined by the precise nature of the question, the data available and the characteristics of economic activity and poverty in the country in question – there is no single "best" model. This paper has presented a basic methodology which can be applied using only household survey data and limited time resources, along with a set of elaborations upon this methodology which may be adopted as circumstances and resources dictate.

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Annex 1: The Basic Methodology[25]

The basic methodology draws on the approach of Nicita, Olarreaga and Soloaga (2002) in their study of the impact of trade reform in Cambodia. Let the income Y of a household be given by:

$$Y = \left(\sum_j p_j^O q_j^O - \sum_k p_k^I q_k^I \right) + \sum_f w_f L_f + \sum_m \sum_n T_{mn} \qquad (1)$$

where p_j^O is the price of output j; q_j^O is the quantity of output j; p_k^I and q_k^I are the corresponding input prices and quantities; w_f is the wage rate for factor f; L_f is the net sale of factor f by the household; and T_{mn} is the net transfer received by household member n from source m.

Note that the first term in equation (1) is the value-added of all production (whether from farming or non-farm enterprises). This includes both marketed production and own consumption. The second term is the value of net factor sales by the household – in the case of most poor households this simply means net labour sales (i.e. employment income minus payments for hired labour) since the only factor which most poor households can sell is their own labour. The final term represents the net transfers received by the household.

Similarly we can write the consumption of the household simply as:

$$C = \sum_i p_i^C q_i^C \qquad (2)$$

where p_i^C is the buying price of good i and q_i^C is the quantity consumed of good i. Note that q_i^C includes own consumption as well as goods purchased from the market.

It is then possible to simulate the impact on household income of price changes induced by structural reforms. In the short run we can assume that all quantities remain fixed so that

$$\Delta Y = \left(\sum_j \Delta p_j^O . q_j^O - \sum_k \Delta p_k^I . q_k^I \right) + \sum_f \Delta w_f . L_f + \sum_m \sum_n \Delta T_{mn} \qquad (3)$$

Similarly the change in consumption assuming that quantities remain fixed is

[25] This methodology draws heavily on "A simple methodology to assess the poverty impact of economic policies using household data. An application to Cambodia. Nicita, Olarreaga and Soloaga (2002).

$$\Delta C = \sum_i \Delta p_i^C . q_i^C \tag{4}$$

It is possible to show that a first-order approximation of the change in money metric utility resulting from a change in the price of a commodity can be given by[26]

$$\Delta MMU = \Delta Y - \Delta C \tag{5}$$

This makes intuitive sense: an increase (say) in the price of a good which is both produced and consumed will increase income and also increase the cost of achieving the original level of consumption – the difference between these is therefore an approximation to the welfare change.

Note that we can combine equations (1), (2), (3) and (4) to write equation (6):

$$\frac{\Delta MMU}{Y} = \left(\sum_j BS_j^O \frac{\Delta p_j^O}{p_j^O} - \sum_k BS_k^I \frac{\Delta p_k^I}{p_k^I} \right) + \sum_f BS_f^W \frac{\Delta w_f}{w_f} + \frac{\sum_m \sum_n \Delta T_{mn}}{Y} - \sum_i BS_j^C \frac{\Delta p_j^C}{p_j^C}$$

where BS_j^O indicates the budget (or income) share of output revenue in total income, BS_j^I is the budget share of input costs, BS_j^W is the income share of net factor income from factor f, and BS_j^C is the budget share of good j in consumption. Thus the first-order percentage change in net income can approximated by the budget shares of income and expenditure on each item times the percentage changes in prices experienced.[27]

[26] See Chen and Ravallion (2002) for an exposition of the theory.
[27] See Minot and Goletti (2000) Appendix 2 for a full derivation.

Annex 2: Modeling Remittances

The paper outlines a number of ways in which we might model remittances. This note elaborates on the suggestion in the paper that we should attempt to incorporate a simple Harris-Todaro model of the migration process.

Imagine that a reform gives rise to growth in employment in a particular sector. Our "standard" technique for allocating people to jobs is to:

1. Estimate a probit for participation in the labour force
2. Estimate a multinomial logit for sectoral participation (including unemployment as base category)
3. Allocate individuals to the labour force according to their probability of participation from the Probit analysis (leaving in individuals who are currently participating even if their probability of participation is low)
4. Allocate new entrants to the labour force to the sector which they are most likely to participate in according to the multinomial logit (one could also allow existing employees to switch sector).

To tackle remittances we could replicate this approach using a Probit on receiving remittances, a multinomial logit to determine the sector of remittances received and a level of remittances regression to determine the amount. However, as argued in the paper, this ignores the fact that sometimes a household has made a prior decision to migrate in order to receive remittances – certainly there is something strange about just giving a household a new remittance without the household having done anything or given anything up.

Instead we may build a little Harris-Todaro module into our standard methodology as follows – the first three steps are the same as above i.e.:

1. Calculate the probability of getting employment (in any sector) using a Probit model
2. Estimate a multi-nomial logit to get the probability of being employed in each sector (relative to the base category of being unemployed)
3. Estimate sectoral wage equations (or at least one wage equation with sectoral dummies). (Alternatively use information on sectoral wages or unit earnings if wages are unavailable, but wages are preferable).

In addition we then:

4. Do a regression of household (NB not per capita) income on household characteristics including household size (or other demographic categories); predict the household income, and then predict the new household income when you remove one household member – do this for each adult household member. Take the percentage change in income resulting from the removal of the household member and multiply this by the actual household income – this is an estimate of the income loss associated with that individual migrating for employment.
5. Calculate the expected income of the migrant individual as:

$$E[y_{mig}] = \sum_j \left(\frac{\Pr(s_j)}{\Pr(s_0)} \right) (1 - \Pr(Job)).w_j \qquad \text{(A2.1)}$$

where $\Pr(s_j)$ is the probability of being employed in sector j; $\Pr(s_0)$ is the probability of being employed in the base category (the multinomial logit predicts this ratio); Pr(Job) is the probability of having a job in any sector (predicted from the Probit regression); and w_j is the estimated wage for sector j.

Now let us define the following variables:

y_n^0	is the original household income of the household with n members
y_{n-1}^{-1}	is the household income reduced by the estimated loss of income resulting from the migration of one individual
y_{n-1}^{-1+}	is the household income reduced by the estimated loss of income resulting from the migration of one individual, but with the remittance received by the household added
y_n^{-1+}	is the household income reduced by the estimated loss of income resulting from the migration of one individual and with the whole value of the income received by the migrant added (NB the subscript is n indicating that it is the income of n individuals)

The original income is known; step 4 above estimates y_{n-1}^{-1}; and step 5 allows us to calculate y_n^{-1+} (by simply adding the expected income of the migrant onto y_{n-1}^{-1}). The only remaining question is how to calculate y_{n-1}^{-1+}.

One simple approach is to estimate a savings rate α. An alternative approach is to assume a "social compact" between the household sending the migrant and the migrant such that they will live at the same per capita income level. If we assume that the migrant sends a share α of their income then we have:

$$\frac{y_{n-1}^{-1} + \alpha.y_{mig}}{n-1} = (1-\alpha)y_{mig} \qquad \text{(A2.2)}$$

which implies that

$$\alpha = \left(\frac{n-1}{n}\right)\left[1 - \frac{\left(\frac{y_{n-1}^{-1}}{n-1}\right)}{y_{mig}}\right] \qquad \text{(A2.3)}$$

In either case y_{n-1}^{-1+} can then be calculated as:

$$y_{n-1}^{-1+} = y_{n-1}^{-1} + \alpha . y_{mig} \qquad \text{(A2.4)}$$

Once the above y variables have been calculated it is possible to calculate the level of household welfare with migration. However, this depends upon our unit of analysis. There are two values which we could take:
a) if the household includes the welfare of the migrant then household welfare can be calculated as: y_n^{-1+}/n
b) if the household only considers the welfare of the remaining members then welfare can be calculated as: $y_{n-1}^{-1+}/(n-1)$

Rather than choose between these options we simply refer to the welfare level of the household with and without migration as W^1 and W^0 respectively. We might therefore expect households to send a migrant out for employment if $E[W^1] > W^0$.

Note that we can calculate both with and without migration values *before* any reform takes place as well as after any reform. To make the distinction clear we therefore refer to:[28]

	Before reform	After Reform
Without migration	W_{BR}^0	W_{AR}^0
With migration	W_{BR}^1	W_{AR}^1

Since W_{BR}^0 and W_{BR}^1 can both be calculated before reform it is possible to put the households in the survey into four groups:

i. Households who don't now receive remittances and would not benefit from migration ($W_{BR}^1 < W_{BR}^0$)
ii. Households who don't now receive remittance and would benefit from migration ($W_{BR}^1 > W_{BR}^0$)
iii. Households who do now receive remittance and would not benefit from migration ($W_{BR}^1 < W_{BR}^0$)

[28] For notational convenience we drop the expectation symbol on the W^1 variables.

iv. Households who do now receive remittance and would benefit from migration ($W_{BR}^{1} > W_{BR}^{0}$)

In the case of group i, households behave in exactly the way we predict since it is not worth their while sending a migrant in search of work. Similarly the third group also behaves as predicted – these are households who are already receiving remittances but for whom it is not worth sending a migrant. This might be because the characteristics of the remaining family members make their expected income from migration less than their income loss resulting from migration; or it may be that the existing source of remittance is not due to migration but from some other source. However, for groups ii and iv we predict that it would make sense for households to send a migrant and yet they do not do so. This suggests that there may be unobserved costs or constraints to such migration for these households. It will be necessary to take into account these constraints when analyzing the impact of reform below.

The Impact of Reform on Poverty

We can now consider the same two types of reform which were described in the paper under modeling labour incomes namely exogenous wage increases and exogenous employment increases. As before, the choice of whether wages or employment adjusts to reform depends upon ones assumption about the elasticity of labour supply.

Wage changes:

As before the impact of exogenous wage changes is easy to calculate by simply applying the assumed percentage increase (say) in wage income to the individuals who work in the affected sector. Similarly a wage increase for migrant workers can be simulated by increasing the remittance income for households receiving remittances from the affected sector.

However, this simple approach doesn't give the full story when we consider the migration model. Wage increases increase the expected value of income for a migrant as shown in equation (A2.1). This will increase the number of households for whom sending a migrant will beneficial. If we simply simulate the impact of a wage increase by increasing the wages of those currently in employment assuming that there is no increase in unemployment then all of these additional migrants will, by assumption, be unsuccessful in obtaining employment. This could even lead to a fall in welfare as migrants are lured by higher wages into unemployment in the urban areas. One way of ensuring that outcomes for migrants are consistent with their expectations is to allow all jobs in the urban areas to be reallocated to existing employees and migrants according to their probabilities of getting a job in the sector. This will have the result that some of those currently employed will become unemployed, but will ensure that some of the migrants obtain jobs.[29]

[29] This is done using the original Probit and multinomial logit distributions and allocating the fixed number of jobs according to the probability of getting a job in the sector as before. One could then re-estimate the Probit and multinomial logit to obtain a new distribution which will accurately reflect the lower standards required to obtain a job (or the higher probability of getting a job with any given set of characteristics). If

Employment changes:
Employment changes can be tackled in a very similar manner to the way in which they are dealt with when modeling labour incomes. Specifically we use the following procedure:

1. As for wage changes, calculate the expected values of welfare after reform with and without migration (W^1_{AR} and W^0_{AR}). The household sends a migrant if the expected value of welfare with migration $W^1_{AR} > W^0_{AR}$.[30]
2. Calculate the probability of each local individual and all the migrants sent being employed in each sector and allocate individuals to jobs in order of their probability until all the available jobs have been filled.[31]
3. If the individuals employed are local, then this simply contributes to the labour income of their household. If however, they are non-local then their income contributes to the remittances received by the household according to the fixed saving or social compact rule described above.
4. Calculate the household's ex post welfare W^{1ex}_{AR}. This is the level of welfare when one knows whether the migrant actually obtained a job.

In this way we can incorporate rational decisions by households regarding migration and remittances into our simple model of the impact of reform upon poverty.

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jobs were then reallocated to all households according to their probability of employment in each sector the new distribution should (on average) generate the correct fixed number of jobs. Of course, the reduced probability of obtaining a job will reduce the number of migrants in the long run – we are interested here in relatively short run effects so we assume that information about the wage increase travels quickly and therefore influences migration decisions first, whereas information on the gradually increasing probability of obtaining employment travels more slowly.

[30] Alternatively one may wish to take into consideration the unobserved costs of migration mentioned before. This can be done by assuming that households who would have benefited from migration (groups ii and iv) but who did not do so, are unable to send migrants, so their welfare level remains at W^0_{AR} even if $W^1_{AR} > W^0_{AR}$. A further issue is who within the household is sent. It is assumed that the household member resulting in the highest expected value of W^1_{AR} is sent – this may not necessarily be the member with the highest probability of employment, since the household will also take into account the loss of income resulting from their departure.

[31] A choice will need to be made here between allocating the new jobs simply to people who do not currently have jobs accordingly to their probability of employment; or allocating people with the highest probability to jobs (if they are made better off by switching) and then filling the jobs which they leave with others accordingly to the same process. Also, as for wage changes, one may wish to re-estimate the probit/multinomial logit once the additional employees have been added to reflect the increased probability of obtaining a job. Here we assume that employment expansions draw from the existing labour force whilst information about the increased probability of employment takes time to filter back to migration decisions.

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